

WHAT IS CLAIMED IS:

1. A method of identifying an abnormal combustion reaction in an operating gas turbine comprising the steps of:
 - a. operating a gas turbine having a compressor, a combustion section, and a turbine, such that hot combustion gases generated in the combustion section flow through the turbine and exit the turbine as exhaust gases;
 - b. measuring temperatures of the exhaust gases at a plurality of positions arranged downstream of the turbine;
 - c. identifying one of the measured exhaust gas temperatures as an abnormal exhaust gas temperature;
 - d. correlating the abnormal exhaust gas temperature with a corresponding location in the combustion section, and
 - e. identifying the corresponding location in the combustion section having the abnormal combustion gas temperature.
2. A method of identifying an abnormal combustion reaction in an operating gas turbine as in claim 1 wherein the combustion section includes an array of combustion chambers and step (e) further comprises identifying a combustion chamber corresponding to the location in the combustion section having the abnormal combustion gas temperature.
3. A method of identifying an abnormal combustion reaction in an operating gas turbine as in claim 1 wherein step (e) further comprises determining a swirl angle indicative of a degree of rotation experienced by the combustion gases flowing from the combustion section to the plurality of positions where exhaust gas temperatures are measured.
4. A method of identifying an abnormally hot or cold combustion reaction in an operating gas turbine comprising the steps of:

a. operating a gas turbine having a compressor, a plurality of combustion chambers arranged in a circumferential array, and a turbine, such that hot combustion gases generated in the combustion chambers flow through the turbine and exit the turbine as exhaust gases;

b. measuring temperatures of the exhaust gases at a plurality of positions arranged circumferentially in the exhaust gases;

c. identifying an abnormally hot or cold exhaust gas temperature as being a temperature that differs from a baseline temperature by a predetermined threshold temperature difference;

d. correlating the abnormally hot or cold exhaust gas temperature with a corresponding at least one of the combustion chambers, and

e. identifying the at least one of the combustion chambers as corresponding to the abnormally hot or cold exhaust gas temperatures.

5. A method of identifying an abnormally hot or cold combustion reaction in an operating gas turbine as in claim 4 wherein the step of correlating the abnormally hot or cold exhaust gas temperature with a corresponding at least one of the combustion chambers includes determining a swirl angle indicative of a degree of rotation experienced by the combustion gases flowing from the combustion chambers to the plurality of positions where exhaust gas temperatures are measured.

6. A method of identifying an abnormally hot or cold combustion reaction in an operating gas turbine as in claim 4 wherein the baseline temperature is a median temperature of the measured temperatures.

7. A method of identifying an abnormally hot or cold combustion reaction in an operating gas turbine as in claim 4 further comprising periodically repeating steps (b) to (e).

8. A method of identifying an abnormally hot or cold combustion reaction in an operating gas turbine as in claim 4 further comprising repeating steps (b) to (e) after changing the predetermined threshold difference.

9. A method of identifying an abnormally hot or cold combustion reaction in a gas turbine as in claim 4 further comprising generating a presentation of exhaust gas temperatures.

10. A method of identifying an abnormally hot or cold combustion reaction in a gas turbine as in claim 4 wherein the correlation of the exhaust gas temperature with the corresponding at least one of the combustion chambers is performed with exclusively linear algorithms.

11. A system for identifying an abnormal temperature in a combustion section of a gas turbine comprising:

an array of temperature sensors arranged in an exhaust passage of the gas turbine, and each temperature sensor outputs a temperature signal indicative of a temperature of combustion gases proximate the sensor;

a computer system including a memory storage device, a processor, an output device, and an input device, wherein the processor is operatively coupled to the storage device, output device and input device;

the memory storage device including information indicative of temperature signals from the temperature sensors, and algorithms for identifying an abnormal combustion gas temperature signal based on the temperature signals, and algorithms for correlating a temperature sensor outputting a temperature signal indicative of the abnormal combustion gas temperature to a location in the combustion section which is experiencing an abnormal combustion gas temperature, and

the output device providing an indication of the location in the combustion section experiencing the abnormal combustion gas temperature.

12. A system for identifying an abnormal temperature as in claim 11 wherein the algorithms include a swirl angle algorithm to estimate the swirl angle experience by combustion gases flowing from the combustion section to the temperature sensors.
13. A system for identifying an abnormal temperature as in claim 11 wherein the indication of the location in the combustion section is a polar graph of the combustion section with an indicator at a position on the graph corresponding to the location in the combustion section experiencing the abnormal combustion gas temperature.